VER
Vascular & Endovascular Review

Therapeutic Efficacy of Low-Level Laser Therapy on the Breast Engorgement after Delivery

Walaa Khamis Swar[1], Alyaa Abdallah Atallah Ahmed Zaid[2]

1 Department of Women's Health, PHD, Faculty of Physical Therapy, Suez University, Egypt.
2 Lecturer of physical therapy for internal medicine and geriatrics, faculty of physical therapy, Horus University, New Damietta, Egypt.

***Corresponding Author**
1Department of Women's Health, PHD, Faculty of Physical Therapy, Suez University, Egypt, e-mails: Walaa.swar@the.suezuni.edu.eg

ABSTRACT

Background: For lactating mothers, Engorged breasts Problem is a serious problem which may be followed by more serious situations, such as plugged ducts, cracked nipples and mastitis, which affect the life of any mother. Breast engorgement affects nearly 85% of almurdieats. **Objective:** The aim of this study was to evaluate the effectiveness of low-level laser therapy in treating breast engorgement following childbirth. **Methods:** This study assessed the efficacy of low-level laser therapy in treating breast engorgement in lactating mothers. Fifty mothers with breast engorgement were divided into two groups:
- Control Group (A): Received traditional treatment (moist heat pack for 10 minutes and Aloeo oil massage for 30 minutes)
- Study Group (B): Received traditional treatment + low-level laser therapy (6328 nm, 25 mw, 10 minutes, 1 session/day, 1 week)
Outcome measures included a VAS pain scale and a 6-point self-rated breast engorgement scale. The study was approved by the Research Ethical Committee, Faculty of Physical Therapy, Cairo University (Approval No. P.T.REC/012/006054, dated 2-9-2025). **Results:** Significant reduction in the VAS of the group (A) after treatment than before treatment (p=0.0001) was found. Significant reduction in the VAS of the group (B) after treatment than before treatment (p=0.0001). When comparing the results of both groups (A&B), there was no statistically significant difference (t value-0.341) and (p value =0.735) before treatment. After treatment, there was no significant difference between the groups (A&B) (t value=4.413) and (p value=0.361). After treatment, a significant reduction in breast engorgement was observed in group A, as indicated by the 6-point self-rated breast engorgement scale, compared to before treatment (P=0.0001). Group B showed a significant decrease in breast engorgement scores on the 6-point self-rated scale after treatment compared to before treatment (P=0.0001). Before treatment, groups A and B had similar breast engorgement scores, with no significant difference between them (z value=- .222) and (p value=0.825). After treatment, a significant difference was found between groups A and B, indicating a difference in treatment outcomes (z value=0.95) and (p value=0.000), with more reduction in group B. **Conclusion:** Low-level laser therapy is an effective treatment for postpartum breast engorgement, with results indicating a significant therapeutic benefit.

KEYWORDS: Breast engorgement, low-level laser therapy, moist heat packs, Aloe oil massage.

How to Cite: Walaa Khamis Swar, Alyaa Abdallah Atallah Ahmed Zaid (2025). Therapeutic Efficacy of Low-Level Laser Therapy on the Breast Engorgement after Delivery, Vascular and Endovascular Review, Vol.8, No.13s, 86-93.

INTRODUCTION

Breast engorgement occurs when milk accumulates in the breasts, causing swelling, hardness, and severe pain. This condition is more common in mothers who follow a scheduled feeding routine, experience breastfeeding difficulties, or are separated from their infants. This leads to in sufficient emptiness of breasts, if this problem is handled in a good manner it may subside within 12 to 48 hours (1). Breast engorgement affects approximately 70-83% of postpartum mothers, typically manifesting within the first week. If left unaddressed, it can lead to complications such as mastitis, nipple trauma, and decreased milk supply. These problems may lead to breastfeeding stop (3). Areolas, body of one or both breasts are the places where engorgement could be happened (4). Neglecting breast engorgement can lead to plugged ducts and breast infections (5).
Additionally, engorgement can cause difficulties with latching, potentially disrupting breastfeeding. This issue may be exacerbated by abrupt weaning or illness in the infant. (6).
The mother also could be the cause of the problem, as it known after delivery; dehydration is a serious problem so as intravenous fluids are prescribed with the tendency of fluid retention that may occur leading to inefficient action of the lymphatic system (7). Treatment approaches for breast engorgement encompass both pharmacological and non-pharmacological interventions. Medications like ibuprofen, serrapeptase, oxytocin, and protease are often employed to alleviate symptoms and facilitate relief. (8). Several non-pharmacological approaches can help manage breast engorgement, including:
- Herbal remedies: cold cabbage leaves, ginger, cactus, aloe, and hollyhock compresses
- Supportive measures: uplifting bras
- Milk expression: manual and electric breast pumps
- Physical therapies: massage, ultraviolet, TENS, laser, ultrasound, acupuncture, and acupressure
- Alternative techniques: scraping therapy

- Temperature therapies: hot and cold packs (9).

Research supports the effectiveness of combining traditional therapies with modalities like ultrasound, TENS, or alternating hot and cold packs in alleviating breast engorgement pain. These combinations can provide significant relief for mothers experiencing discomfort and tenderness in this case (10).

Photo-biomodulation, also known as low-level laser therapy, has anti-inflammatory effects, reducing or eliminating inflammation and associated edema (breast engorgement or swelling). This promotes healthy breast tissue and alleviates pain, supporting continued breastfeeding (11).

This study aimed to investigate the therapeutic efficacy of low-level laser therapy in managing postpartum breast engorgement.

MATERIALS AND METHODS

This study was a randomized control study. Forty women diagnosed with breast engorgement participated in this study. The participants were randomly selected from Green Apple Clinic in El-Mahalla El-Kobra, Gharbia, to evaluate the effectiveness of low-level laser therapy in treating breast engorgement. The study time was six months, starting from March 2023 and ending in august 2023. Their age ranged from 19 to 34 years. Their BMI was ranged from 25-30 kg/m^2. Women were excluded if they were BMI higher than 30 kg/m^2, mothers who have breast softness; mothers who depend on bottle feeding, mothers with breast cancer, mothers who use cardiac pace maker or having any conditional problem in the skin, mothers who have uncontrolled diabetes, fever conditions, mothers who have arrhythmia or any circulatory insufficiency and mothers who have photophobia. There were two groups in this research under pre and post experimental study design. The study included two groups: Group A (control group) comprising 25 lactating mothers with breast engorgement, who received traditional treatments, and Group B (intervention group) who received low-level laser therapy in addition to traditional treatments in form of Aloe oil massage for 5 minutes followed by moist heat packs application for 10 minutes before lactation on the breast that engorged from the third day of puerperium.

Group B (study group) received the same traditional therapy as Group A, plus low-level laser therapy applied to the affected breast. The laser therapy parameters were as follows:

Scanning applicator, 808 nm as wave length, energy dose 0.1-10 J/cm2, power 20 mw, continuous mode, size of treatment is in axis X and Y (20-100 % in both axes), Distance applicator to the patient ranged from 2-100 cm, pulse frequency 1-5000 Hz, duration was 15 minutes, one week was the treatments duration, with one session per day. Subjective outcome measures including; a VAS scale to measure pain and a 6-point self-rated breast engorgement scale for detecting the breast engorgement degree.

Each mother in both groups (A and B) was assessed through visual analogue scale for pain intensity detection and six-point self-rating scale for breast engorgement severity detection.

The study received approval from the Research Ethics Committee of the Faculty of Physical Therapy, Cairo University, with approval number P.T.REC/012/006054, dated 2-9-2025.

Evaluative Measures

Evolutions were done for both groups (A& B) pre and post treatment (one week). The evaluator was blinded to group assignments and didn't attend the treatment sessions.

1. Weight and height: BMI was calculated for women in groups A and B using the equation: BMI = weight (kg) / height (m²), with participants wearing a thin layer of clothing.

2. Pain severity was measured using a Visual Analogue Scale (VAS) for mothers in groups A and B, pre- and post- treatment. With 0 means no pain, 1-3 for mild degree of pain, 3-5 indicates moderate degree of pain, 5-7 refers to extreme degree of pain, 7-9 for very severe pain, and 9-10 concluds the worst pain degree (12).

3 Breast engorgement degree:

Each mother in groups A and B was evaluated using a 6-point self-rated breast engorgement scale, assessing breast engorgement before and after treatment, with scores ranging from 1 (normal softness) to higher values indicating greater engorgement normal, 3 means hard but not tender, 4 means hard with slight degree of tenderness, 5 means hard tender breast, and 6 means very hard and the most severe degree of tenderness (13).

Treatment measures

Both groups (A& B) admitted to their treatment session once per day for 1 week.

1 Moist heat pack

Mothers in both groups A and B received a treatment session consisting of a 10-minute moist heat towel application, followed by 30 minutes of Aloe oil massage to help alleviate breast engorgement before feeding of the baby then she fed her baby, 7 sessions per week for one week; Fig (1).

Fig. (1): Moist heat pack application

2 Low-level laser therapy (ASTAR 33 Swit st.,43-382 Bielsko-Biala, Poland tel, +48338271856, fax +483338292441, Etius family, Polaris 2)

Mothers in group B received traditional therapy (same as group A) plus low-level laser therapy on the engorged breast, with the following parameters:

Scanning applicator, 808 nm as wave length, energy dose 0.1-10 J/cm2, power 20 mw, continuous mode, size of treatment is in axis X and Y (20-100 % in both axes), Distance applicator to the patient ranged from 2-100 cm, pulse frequency 1-5000 Hz, duration was 15 minutes, one week was the treatments duration, with one session per day.

3. Aloe oil breast massage

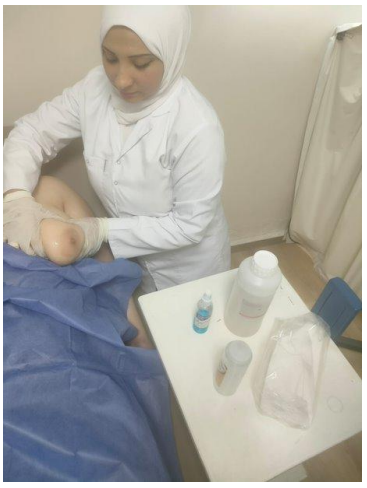

Fig. (2): Aloe oil massage for breast

Mothers in both groups A and B received Aloe oil breast massage for 30 minutes per session, 7 sessions per week for 1 week, before feeding their babies. Here's how it went down:

- Mom was comfy in a half-lying position with back support
- Therapist exposed the engorged breast, applied Aloe oil for comfort, and did gentle circular massage around the breast
- Used 4 fingers of one hand on top, 4 fingers of the other hand on the bottom, with circular rhythmic motion
- Hands alternated around the areola, sliding to the breast base with gentle rotation
- Hand expression was done every 3-4 times, with gentle pressure behind the nipple base, pushing milk towards the nipple Fig. (2).

Low-level laser therapy (ASTAR 33 Swit st.,43-382 Bielsko-Biala, Poland tel, +48338271856, fax +483338292441, Etius family, Polaris 2)

Mothers in group B received low-level laser therapy on the engorged breast. Before starting, they were informed about potential temporary discomfort or increased pain, which would subside with continued treatment. Most reported a soothing warmth sensation. Both mom and therapist wore safety goggles. Here are the laser therapy parameters:

Scanning applicator, 808 nm as wave length, energy dose 0.1-10 J/cm2, power 20 mw, continuous mode, size of treatment is in axis X and Y (20-100 % in both axes), Distance applicator to the patient ranged from 2-100 cm, pulse frequency 1-5000 Hz, duration was 15 minutes, one week was the treatments duration, with one session per day. Mom was comfy in a half-lying position with cushions supporting her body, covered by a sheet for privacy. Both mom and therapist wore protective goggles. She was informed about potential sensations during treatment. The engorged breast was exposed, cleaned with disinfectant, and then the laser therapy started:

- Unit code: CB
- Selected program with set parameters
- Laser applicator chosen and confirmed
- Parameters set and edited as needed
- Started with "start" key, paused with "STOP" if needed, and resumed by repeating steps Fig. (3).

Fig. (3) LLLT application for group (B).

Statistical analysis

Statistical analysis was done using SPSS version 25. Here's what they did:

- Compared mean age, weight, height, and BMI of groups A and B using descriptive stats and unpaired t-test
- Compared VAS and breast engorgement scale between groups A and B using unpaired t-test
- Compared VAS and breast engorgement scale within each group using Paired t-test
- Significance level: $P < 0.05$

RESULTS

The current study was conducted on 50 participants. They were assigned into two equal groups. Group (A) consisted of 25 participants with mean age and BMI values of 26.52±4.17 years and 25.28±1.67 kg/m2 respectively. Group (B) consisted of 25 participants with mean age and BMI of 26.96±4.13 years and 25.72±1.78 Kg/m2 respectively. As indicated by the independent t test, there were no significant differences ($p>0.05$) in the mean values of age and BMI between both tested groups (Table 1).

Independent t test	**Group (A) $\bar{X}$±SD**	**Group (B) $\bar{X}$±SD**	**MD**	**t- value**	**P-value**
Age (years)	26.52±4.17	26.96±4.13	-.44	-.364	.613
Height (cm)	158±2.57	157.8±4.38	-,96	,945	,19
Non parametric T test Mann Whitney test	**Group (A)**	**Group (B)**	**Z-value**	**P-value**	
BMI (kg/m^2)	25.28	25.72	-,109	,913	
Weight (Kg)	24.62	23.30	-,336	,737	

X-, mean; SD, standard deviation; P value, probability value.

Within group comparison:

In group A and B, there was a substantial reduction in VAS and the 6-point self-rated breast engorgement scale after treatment relative to pretreatment ($p > 0.001$). The VAS and 6-point self-rated breast engorgement scale decreased by 23.75 and 4.55 percent in group A respectively, while they decreased by 42.991 and 48.87 percent in group B respectively (figure 4, table (2& 3)).

Between groups comparison:

In both variables, there was no substantial difference between the two groups before treatment ($p > 0.05$). After therapy, there was no substantial difference in VAS between group A and group B ($p > 0.05$) and for the engorgement 6 points scale, there was significant difference in group B than in group A ($P < .05$) (figure 4, table 2&3).

Table 2: Mean VAS pre and post treatment of the group A and B

VAS	Group (A) X^{-}±SD	Group (B) X^{-}±SD	MD	t-value	p-value
Before treatment	8.44±1.294	8.56±1.19	-,1200	-.341	,735
After treatment	6.52±1.122	4.88±1.48	1.6400	4.413	.361
MD	1.920	3.680			
% of change	77.25	57.009			
% 0f pain reduction	23.75	42.991			
t-value	5.018	17.208			
P value	,228	,002			

X-, mean; SD, standard deviation; P value, probability value.

Table 3: Mean 6-point self-rated breast engorgement scale pre and post treatment of the group A and B

Breast engorgement 6 points scale (Non-parametric Wilcoxon signed ranks test)	Group (A) X^{-}±SD	Group (B) X^{-}±SD	z-value	p-value
Before treatment	5.28±.737	5.32±,748	-.222	,825
Post treatment	5.04±,735	2.72±,737	-5,960	.000
% of change	95.45	51.128		
% of reduction	4.55	48.87		
Z-value	-2.449	-4.451		
P-value	.014	.06		

X-, mean; SD, standard deviation; P value, probability value.

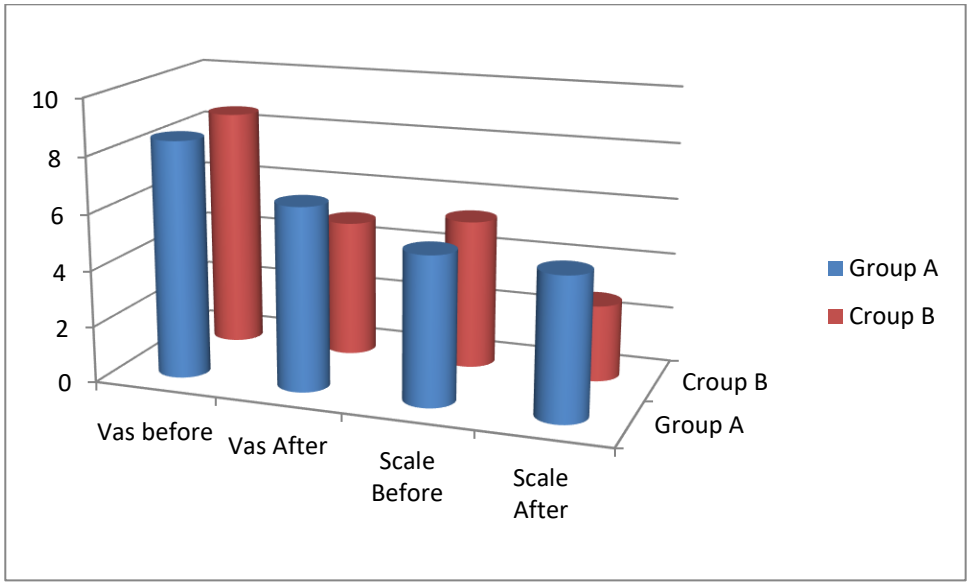

Figure 4. Mean VAS and 6-point self-rated breast engorgement scale pre and post treatment of the group A and B.

DISCUSSION

Engorgement of the breast is a serious problem that faces the mother immediately after labor and this problem may be continue throughout the breast-feeding time. Breastfeeding is crucial for the baby, and addressing issues like pain can help moms keep nursing. Pain affects both mom and baby, so finding solutions is key. Pain may be related to the depression in puerperium, also several time usages of breast for feeding or in ability of the mother or the child to take care of the nipple (14).

This study checked if low-level laser therapy helps with breast engorgement. The present study was carried on fifty mothers suffering from postnatal breast engorgement. Participants were split into two groups; A and B. Pain were assessed using a visual analogue scale before and after treatment in both groups. Before and after treatment, breast engorgement was evaluated by six points self-rated breast engorgement scale.

Fifty mothers who complained from breast engorgement shared in this study. The participants were randomly selected from Green Apple Clinic in El-Mahalla El-Kobra, Gharbia. Their age ranged from 19-35 yrs. Their BMI was ≤ 30≥25 kg/m². The participants were excluded if they were with BMI higher than 30 kg/m2, lactating mothers with soft breasts, nonlactating mothers, suffering from breast cancer, using of cardiac pace maker or having any skin condition.

Mothers were divided into two equal groups Group (A), Control group consisted of 25 lactating mothers that were diagnosed by engorgement, and they received only traditional treatments in form of Group A got:

- Moist heat pack for 10 minutes
- Aloe oil massage for 30 minutes

Group B was given the same treatment as Group A, in addition to LLLT at a wavelength of 6328 nm, with a power of 25 mW,

administered for 10 minutes daily over the course of one week.
Subjective outcome measures include VAS for pain assessment as well as a 6-point self-rated scale for evaluating the degree of breast engorgement.
The current research findings indicate that the VAS of group A substantially decreased following treatment compared to prior to treatment ($p = 0.0001$). The following treatment 6-point self-rated breast engorgement scale for group A was substantially lower than the prior to treatment score for the same group ($p = 0.0001$).
Wong et al., who supported the study's findings, found ultrasound as effective as other treatments for breast engorgement. Although treatments differed, all reduced engorgement and tenderness. Treatment duration varied between groups. (15).
Supporting the results of this study, Zakarija-Grkovic et al. acknowledged that the use of techniques such ultrasonography therapy, acupuncture, acupressure, massage, hot/cold packs, as well as herbal compresses. Cold packs might reduce blood flow, while warm packs can worsen swelling, but both can help relieve breast engorgement. Using cabbage leaves to alleviate breast engorgement is a common practice (16)
The study's findings are corroborated by Cotterman, who asserts that reverse pressure softening, a method employing gentle positive pressure with the fingertips to soften the areola, has demonstrated efficacy in enhancing infant attachment to the breast, thereby serving as a potential strategy for mitigating breastfeeding complications during engorgement (17).
This study's findings corroborated those of Mass, who suggested a combination of methods to empty the breast to reduce pain, make breastfeeding easier, and avoid problems as a treatment for breast engorgement. These encompass the application of moist heat to the breast before feeding to facilitate oxytocin absorption, frequent feeding, softening the areola prior to attachment, and ensuring proper positioning and attachment of the infant to the breast during nursing (18).
The study's findings were consistent with those of Mannel et al., who acknowledged that administering cold compresses after feeding, coupled with analgesics (like paracetamol) and anti-inflammatory drugs (like ibuprofen), if necessary, and giving light massages both before and after feeding, It is crucial to provide skilled support to help the mother attach her infant to the breast as quickly and frequently as possible in order to alleviate engorgement and maintain breastfeeding. Consistent hand-expressing or pumping of milk for comfort is advised in cases where breastfeeding is not feasible, in addition to other symptomatic interventions (19).
Anne et al. demonstrated that therapeutic breast massage during lactation alleviates acute breast pain caused by milk stasis. Therapeutic Breast Massage during Lactation (TBML) helped moms deal with mastitis, engorgement, as well as clogged ducts.
- 42 breastfeeding women received TBML and reported on pain and complications
- Data collected before and after TBML
- Follow-up questionnaires were sent two days, two weeks, as well as 12 weeks thereafter.
- A separate group of 73 engorged moms were enrolled to compare severity Results:
- Reasons for consultation: engorgement (36%), blocked ducts (67%), mastitis (29%)
- Cases had significantly more severe engorgement than controls (47% vs 7%, $P < .001$).
-The initial pain level was 6.4 out of 10. TBML resulted in a substantial reduction in breast pain (6.4 vs 2.8, $P < .001$) and alleviated nipple pain (4.6 vs 2.8, $P = .013$).
- All women indicated an instant alleviation of pain
-At the 12-week follow-up, 65% reported that massage therapy was highly beneficial.
- Women discovered the strategies acquired to be beneficial for managing future mastitis or obstructed ducts.
During the study follow-up, participants found the skills acquired during the office visit to be quite beneficial for managing similar episodes at home (20).
Foda et al. concurred with this study, noting that hot packs are extensively utilized, alongside traditional Chinese remedies like Gua Sha scraping therapy. In Japan, Oketani breast massage, a connective tissue technique created by midwife Sotomi Oketani and administered by specially trained practitioners, is widely embraced by nursing women. It has been demonstrated to influence the composition of breast milk, augmenting the fat content (21).
Contrary to the findings of Witt et al., who documented this in their research on breast engorgement throughout lactation. Three studies employing cabbage leaves or cabbage leaf extract demonstrated no significant benefit. In the management of breast engorgement, ultrasonography therapy and placebo had equivalent efficacy (22).
Certain interventions such as hot/cold packs, Gua-Sha, acupuncture, cabbage leaves, as well as proteolytic enzymes may alleviate breast engorgement; however, little data exists that supports their widespread application. Comprehensive study is urgently required on the management of breast engorgement Lindeka et al. (23).
Breast engorgement is when breasts get swollen and inflamed due to increased blood flow and milk supply. Heat therapy alone may increase any swelling so as alternate hot and cold application in the management of heel pain will be more beneficial, Dhananjay Arankalle et al. (24).
Moist heat therapy is likely not essential for every breastfeeding mother. Certain mothers encounter greater challenges with breastfeeding than others. Engorgement can be exceedingly uncomfortable, particularly when lactation initially commences or when feeding/pumping schedules become inconsistent. This may lead to prolonged retention of milk in a duct, perhaps resulting in obstructed milk ducts or mastitis, Resmy et al., (25).
Group B got traditional therapy plus low-level laser therapy on the engorged breast. the laser therapy parameters were:
Scanning applicator, 808 nm as wave length, energy dose 0.1-10 J/cm2, power 20 mw, continuous mode, size of treatment is in axis X and Y (20-100 % in both axes), Distance applicator to the patient ranged from 2-100 cm, pulse frequency 1-5000 Hz, duration was 15 minutes, one week was the treatments duration, consisting of one session each day. Subjective outcome measures include VAS for pain assessment as well as a 6-point self-rated scale for evaluating the degree of breast engorgement.
The findings of this investigation indicated a substantial reduction in the VAS of group B following treatment in comparison with prior to treatment ($p = 0.0001$). Moreover, group B exhibited a substantial reduction in the 6-point self-rated breast engorgement scale following treatment in comparison with prior to treatment ($p = 0.0001$).
The findings of the current investigation may be clarified by the findings of Coca et al., who indicated that LLLT, considerably diminishes or reduces inflammation. Additionally, the oedema, or swelling, that is often seen with this illness is either reduced or removed, leading to the development of healthy breast tissue. The alleviation of pain and inflammation will likely promote the

sustained practice of lactation (26).

The findings of this study concurred with those of Betty et al., who indicated that LLL alleviates pain and swelling in women suffering from breast cancer-related lymphedema (27).

LLLT is a simple, low-risk treatment that:

- Reduces pain & accelerates wound healing
- Improves tissue organization
- Has anti-inflammatory & immune-modulating effects
- Used for painful nipple lesions (despite limited studies)
- May increase milk production in women with low supply, Buck et al. (28).

Nipple pain, engorgement, as well as damage are prevalent, affecting more than half of breastfeeding women, often characterized by aching, cracked, bleeding, as well as blistered nipples, often accompanied by fissures and abrasions. LLLT is notably successful in speeding the healing of damaged nipples, decreasing swelling, as well as alleviating pain Tait et al (29).

Kelly et al. reported that LLLT is helpful in the management of breast-feeding problems as painful nipple, swelling and edematous breast due to accumulation of milk and unscheduled feeding of the baby (30).

The results of the study agreed with Laurie Kilmartin et al., who made a pilot study and the results was that there was a significant impact of LLLT benefit on breast lymphedema (31).

In contrast the results of the study is not agreed with Elizabeth, who reported that Patient satisfaction is key to the perceived success of the procedure, low level laser therapy may cause some pain throughout the session and the patient may be unsatisfied about that ,therapist should tell the patient about all these risks and the patient may refuse this modality of treatment (32).

Also, Tina and Monica disagreed with the results of this study, they reported that a lot of hazards and complications may affect the patient due to usage of LLLT and so on Modern laser as well as light-based systems have evolved to meet the requirement for clinically effective.

treatments and the need for safer technologies which may assured by a good choice of the device type that is fitted for each case, so more researches should be done on this era (33).

Laser dermatology's a growing field, used for both aesthetic & medical conditions. With more devices available, complications are rising, but tech advancements have improved safety. Knowing potential complications & prevention is key for any practitioner who uses such technology, this was the opinion of Firas about usage of LLLT (34).

CONCLUSION

In conclusion, low-level laser therapy is an effective treatment for postnatal breast engorgement, demonstrating a substantial change in both the Visual Analog Scale (VAS) as well as the 6-point scale following sessions, along with a notable reduction in pain as well as engorgement among the subjects.

REFERENCES

1. akarija-Grkovic, Irena; Stewart and Fiona. 2020:"Treatments for breast engorgement during lactation". The Cochrane Database of Systematic Reviews. (9).
2. Chiu, Jin-Yu; Gau, Meei-Ling; Kuo, Shu-Yu; Chang, Yung-Hsien; Kuo, Su-Chen; Tu and Hui-Chuan.2010: "Effects of Gua-Sha Therapy on Breast Engorgement: A Randomized Controlled Trial". Journal of Nursing Research. 18 (1): 1–10.
3. "Management of breast conditions and other breastfeeding difficulties"2017. NCBI - National Center for Biotechnology Information, part of the US National Library of Medicine.
4. Santos, Kamila Juliana da Silva; Santana, Géssica Silva; Vieira, Tatiana de Oliveira; Santos, Carlos Antônio de Souza Teles; Giugliani, Elsa Regina Justo; Vieira, Graciete Oliveira 2016:"Prevalence and factors associated with cracked nipples in the first month postpartum". BMC Pregnancy and Childbirth. 16 (1): 209. ISSN 1471-2393.
5. Berens P, Brodribb W. ABM Clinical Protocol# 20, 2016: Engorgement, Revised 2016. Breastfeed Med. 11(4):159-163.
6. Lawrence M., and Ruth A. 2016: Breast feeding: a guide for the medical profession, 8th edition, J Philadelphia, 26 (10): 2977-2966
7. Zarshenas M., Zhao Y., Poorarian S., Binns C., and Scott J. 2017: Incidence and risk factors of mastitis in shiraz, Iran: Results of a cohort study, breast feeding medicine J., 12 (5): 290-296.
8. Boi B et al. 2012: The effectiveness of cabbage leaf application (treatment) on pain and hardness in breast engorgement and its effect on the duration of breastfeeding. JBI Libr Syst Rev. 10(20):1185-1213.
9. Saidy T., Aboushady R. 2016: Effect of two different nursery approach in reduction of breast engorgement among postnatal women, Journal of nursing education practice, Egypt; 6(9): 19-26.
10. Z McLachlan, E J Milne, J Lumley, B L Walker. 1991: Ultrasound treatment for breast engorgement: A randomised double-blind trial,37(1):23-8.
11. Majorana, Raj G. Nair, Vinisha Ranna, Wim J. E. Tissing, Anusha Vaddi, Rachel Lubart, Cesar Augusto Migliorati, Rajesh V. Lalla, Karis Kin Fong Cheng & Sharon Elad on behalf of The Mucositis Study Group of the Multinational Association of Supportive Care in Cancer/International Society of Oral Oncology (MASCC/ISOO). 2019: Systematic review of photobiomodulation for the management of oral mucositis in cancer patients and clinical practice guidelines, Supportive Care in Cancer volume 27, pages3969–3983.
12. McLachlan z., Milne E., Lumley J., and walker B. Ultrasound treatment for breast engorgement. 2015: a randomized double-blind trial, Aust J physiother, 37(1):23-28.
13. Witt A., Mason M., Burgess K., Flock S., and Zyzanski S. 2014: A case control study of bacterial species and colony count in milk of breastfeeding women with chronic pain, Breastfeeding Med., 9(5): 29-34
14. Chiu, Jin-Yu; Gau, Meei-Ling; Kuo, Shu-Yu; Chang, Yung-Hsien; Kuo, Su-Chen; and Tu, Hui-Chuan.2010: "Effects of Gua-Sha Therapy on Breast Engorgement: A Randomized Controlled Trial". Journal of Nursing Research. 18 (1): 1–

10.
15. Wong B., Chan Y., Leow M., Lu Y, Chong Y., Koh S and He H. 2017: Treatments for breast engorgement during lactation, Int J Nurs Stud., 76(1):92-99.
16. Zakarija-Grkovic, Irena; Stewart and Fiona: "Treatments for breast engorgement during lactation". The Cochrane Database of Systematic Reviews. 2020 (9)
17. Cotterman KJ. 2004: Reverse pressure softening: a simple tool to prepare areola for easier latching during engorgement. Journal of Human Lactation 20(2):227-37.
18. Mass M. Breast pain 2004: engorgement, nipple pain and mastitis. Clinical Obstetrics and Gynecology 47(3):676-82.
19. Mannel R, Martens PJ and Walker M. 2013: Core Curriculum for Lactation Consultant Practice. 3rd edition. Burlington: Jones & Bartlett Learning.
20. Ann M Witt, Maya Bolman, Sheila Kredit and Anne Vanic. 2016: Therapeutic Breast Massage in Lactation for the Management of Engorgement, Plugged Ducts, and Mastitis Feb;32(1):123-31.
21. Foda MI, Kawashima T, Nakamura S, Kobayashi M, and Oku T. 2004: Composition of milk obtained from unmassaged versus massaged breasts of lactating mothers. Journal of Pediatric Gastroenterology and Nutrition 38:484-7.
22. Witt A., Smith S., Mason M., and Flocke S. 2012: Integrating routine lactation consultant support into a pediatric practice, Breastfeed Med., 7(1):38-42.
23. Lindeka Mangesi and Irena Zakarija-Grkovic. 2016; Cochrane Database Syst Rev. (6): Treatments for breast engorgement during lactation
24. Dhananjay Arankalle, Jon Wardle, and Pradeep M K Nair. 2016: Alternate hot and cold application in the management of heel pain: A pilot study 29:25-28.
25. Resmy V, Nalini S.J., and Sumathi, G. 2014: Effect of Lukewarm Water Compress on Prevention of Nipple Pain and Breast Engorgement Among Primiparous at A Selected Hospital in Chennai.Journal of Science. 4(10). 620-624.
26. Kelly Pereira Coca, Karla Oliveira Marcacine, Mônica Antar Gamba, Luciana Corrêa, Ana Cecília Corrêa Aranha, and Ana Cristina Freitas de Vilhena Abrão. 2016: Efficacy of Low-Level Laser Therapy in Relieving Nipple Pain in Breastfeeding Women: A Triple-Blind, Randomized, Controlled Trial, 17(4):281-9.
27. Betty Smoot, Laura Chiavola-Larson, Jeannette Lee, Hidelisa Manibusan, and Diane D Allen. 2015: Effect of low-level laser therapy on pain and swelling in women with breast cancer-related lymphedema: a systematic review and meta-analysis, 9(2):287-304.
28. Buck M.L., Eckereder G., and Amir L.H., (2016): Low level laser therapy for breastfeeding problems, Breastfeeding Review, Vol. 24, No. 2; 27-31
29. Tait P. Nipple pain in breastfeeding women: causes, treatment, and prevention strategies" (Published in 2000).. Journal of Midwifery and Women's Health 45:197–201.
30. Kelly Pereira Coca, PhD., Karla Oliveira Marcacine., Mônica Antar Gamba, PhD., Luciana Corrêa, PhD., Ana Cecília Corrêa Aranha, PhD., Ana Cristina Freitas de Vilhena Abrão, PhD. "Efficacy of Low-Level Laser Therapy in Relieving Nipple Pain in Breastfeeding Women" (2016, Vol 17, Issue 4, p281-289).
31. Brent N., Rudy S.J., Redd B., Rudy T.E., and Roth L.A. "Sore nipples in breast-feeding women: A clinical trial of wound dressings vs conventional care" (1998) 152: 1077-1082.
32. Elizabeth I McBurney. 2002: Side effects and complications of laser therapy, 20(1):165-76.
33. Tina S Alster, and Monica K Li. (2020) - Dermatologic Laser Side Effects and Complications: Prevention and Management. 21(5):711-723.
34. Firas Al-Niaimi. 2016: Laser and energy-based devices' complications in dermatology, 18(1):25-30.